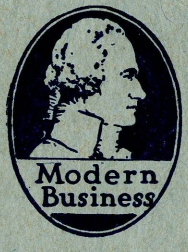
1922

Cost accounting system for a bank

Alexander Hamilton Institute

A Cost Accounting System for a Bank



REPORT No. 45

ALEXANDER HAMILTON INSTITUTE
ASTOR PLACE, NEW YORK

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ALEXANDER HAMILTON INSTITUTE
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A COST ACCOUNTING SYSTEM FOR A BANK

OUTLINE

PREFATORY NOTE

The constantly diminishing margin of profit presents a perplexing problem to many bank executives today. In order to arrive at a satisfactory solution of this problem a knowledge of basic costs is essential. Without it, the rate of return is regulated almost exclusively by competition. This is unscientific and often ruinous.

In this Report a system of cost accounting is presented that will furnish the desired data. Several methods of obtaining this information are discussed in their relation to the system, for the purpose of giving it the flexibility necessary to render it adaptable to any bank.

The Institute is indebted to Dr. Charles C. Grove for valuable suggestions and material in the preparation of this Report, which was written by W. F. Connelly, Associate Editor of the Alexander Hamilton Institute.

A COST ACCOUNTING SYSTEM FOR A BANK

Plan and Scope

Purpose.—A banking institution is of the same fiber as the ordinary industrial enterprise, subject to the same ills, responsive to the same treatment. In the industrial plant, cost of units of production must be known in order that a profit may be realized. Likewise in a bank, the cost of units of service must be found, to the same end. In manufacturing, each customer's order must bear its own proportion of expense, and in banking each customer's account should bear its pro rata share of the cost of operation.

If, then, a banker can by some means test an account to see if it is bearing its rightful amount of costs, he will be able to separate the unprofitable from the profitable accounts. With these clearly classified, he is in a position to take such steps as may be advisable toward converting the losers into income producers.

To supply such a test is the main purpose of a bank cost accounting system.

Means of Attainment.—A system must be *adapted* and not *adopted* by the bank, that is, it must fit the circumstances of the bank. It must not be unwieldy and cumbersome, requiring the collection of a mass of data the value of which is doubtful, but rather it must be practical and require only such information as will show vital facts.

Some banks may be able to afford only the part time service of one or two clerks for cost purposes while others may be in a position to employ the full time of a score or more. In the former instance, the simplest system would be the logical one. In the latter, a system of considerable refinement could be profitably operated. The particular method and the degree of refinement practicable is a question for each bank to decide for itself.

Cost finding is at the best an inexact science and approximations of greater or lesser accuracy are the resultants of all systems. Average figures are most readily obtainable and within certain limitations

the results from their use compare favorably with the results from the use of exact figures.

This is especially true in banks where departmental lines are not definitely drawn and where the personnel, therefore, is not specialized. In such cases, the specific data required for obtaining strictly accurate costs would not be at hand and it would be impracticable to collect it and maintain it up to date at all times. In large and highly organized institutions, however, a considerable portion of desirable data is compiled in another form which, by re-classifying, can be used for cost purposes.

The same problem arises in industrial costs, namely, how far is it practicable to carry the principle of absolute accuracy. It simmers down to a matter of judgment which would vary in each individual case. One hat manufacturer, for example, might find that while theory demands that the amount of thread used on the hats be applied as direct material to a certain order, yet in practice it would prove more desirable to lump the thread used into an item of overhead to be distributed with indirect expenses. Another manufacturer might, thru a better organization, follow the dictates of theory without hampering production.

In like manner, some banks might find that it interferes unduly with the other work to dig out and compile exact figures, while others whose organization is so developed would find it a relatively easy process. As a specific illustration one banker would be quick to see that the finding of the average item cost would be the extent of refinement justifiable in his institution while another banker whose organization was so divided and equipped would readily obtain the separate costs of its own, the city and the out-of-town items.

It cannot be overemphasized that there is a best method to fit each case, and a cost system that neutralizes its value by its expense is nothing more than an encumbrance.

Outline of Procedure.—The working out of this test for an account involves the problem of finding direct costs and the right proportion of indirect costs that are applicable to each one. The matter of fixing direct cost presents no difficulties whatsoever. The problem of allocating indirect costs or overhead, however, is the one which offers formidable resistance because the correct apportionment is dependent on three variable factors—individual activity, size of individual balance, and the number of accounts carried by the bank at any one time.

It is obvious that all overhead is not attributable to any one class or department of business as, for instance, depositor's commercial accounts; there are other classes such as savings, trust, bond, safe deposit, etc., that contribute a portion to the total expenses. Then again, each account does not make an equal demand on the facilities of the department. In view of these facts, it is clear that it is necessary in order to find a basic rate of expense to be applied against an account, to find the cost of maintaining the particular service or department.

The allocation of cost to an account is without value as a test for profit or loss unless we obtain the income that is traceable to the account. To find the income involves the consideration of sources and rates. Different kinds of investments yield different rates of interest. The wisdom of the bank in investing the available funds is reflected in the average rate of interest received. It is evident, therefore, that the income of the individual accounts depends upon the rate of interest received from the administration of its net cash balance.

The departmental profit comes almost as an incidental figure in our calculations and is a datum of considerable importance since it furnishes a basis of inter-department comparisons, indicating the strong and weak points in the organization.

Having the above plan definitely in mind, it becomes necessary to analyze first the bank's business.

Analysis of Expense

Divisions of Business.—Departmentization or separation of functions of the bank is essential in order that the right proportion of expenses caused by the depositors' items may be found and prorated over the depositors' accounts.

The divisions of business in a bank naturally vary with its size and management. The average bank, however, might be divided into commercial accounts, savings accounts, capital, discounts and loans, and trust departments.

The commercial accounts division is concerned with handling the checking accounts of customers and ordinarily constitutes by far the greatest activity of the average bank.

Capital, discounts and loans division has the responsibility of discounting bills and making loans.

The savings accounts division, of course, handles savings of depositors. These, in contrast to commercial accounts, are not subject to check.

The trust department attends to all matters incidental to administrating wills, estates, etc.

It is not unusual to find such departments as safe deposit, bond, real estate, foreign exchange, etc.

Classification of Expenses.—The usual expenses of a bank are such items as: officers' salaries, employes' salaries, rent, taxes, light and heat, stationery and printing, telephone and telegraph, postage, insurance, surety bonds, depreciation, bad debts. These are divided into two general classifications: direct and indirect.

Those expenses that are clearly identified with any one department, such as clerical workers' salaries, materials, telegrams, etc., are considered as direct expenses altho materials, telegrams, etc., often are considered in general expense, thus leaving clerical labor as the only direct expense.

It is an axiom of cost accounting to reduce the overhead to the smallest amount by applying all expenses possible as direct, and ordinarily this should be observed. Many banks, however, whose clerical forces are not specialized, find it convenient to consider all costs as overhead, calling them administration or operating expenses.

Certain expenses that are incurred solely for one account, as out-of-town telephone calls, credit investigation, etc., are known as special costs and are chargeable directly to the account. These have no part in the discussion of bank expenses.

The indirect or general expenses, or overhead as it is often called, constitute by far the largest part of total expense. Direct costs present no difficulties in distribution since lines are clearly drawn, but indirect costs or overhead offer a weighty problem. Since so large a proportion of expense in a bank is overhead, the accuracy with which it is distributed is more important than if such general costs were only a small proportion of the total.

Keeping in mind the ultimate aim of finding account cost let us proceed, then, to consider by what methods we may distribute overhead so that we may allocate to the commercial accounts division its proportionate share.

Gross Earnings Plan.—There are several methods used in allocating expenses to each department. One method aims to distribute it on the basis of earnings, the theory being that departmental expense bears a direct ratio to earnings. Thus, if the department earnings were $25,000, the total earnings $150,000, and the total overhead to be distributed $40,000, the amount assignable to this department would be: $\frac{25,000}{150,000} \times 40,000 = \$6,666.67$. While this method throws the burden where it can best be borne, it is open to the serious criticism that it penalizes the best managed departments and also protects the weaker ones at the expense of the stronger. In that way it fails to show the true condition and renders department comparisons of doubtful value.

Loanable Funds Plan.—A second plan is to apportion the expense on the basis of loanable funds. This plan presumes that expense varies directly with the net funds to be administered. For instance, let us suppose that the total funds of a bank were $2,000,000, the total provided by a certain department $750,000. the total expenses $40,000, then the department's share would be: $\frac{750,000}{2,000,000} \times 40,000 = \$15,000$.

This obviously is a fairer way than the one previously discussed. It fails to consider, however, the relative amount of expense necessarily incurred by the various departments to produce a certain amount of loanable money. In some departments the producing of funds entails much more routine work than others. In that respect, the distribution is inaccurate.

Percentage Plan.—A third mode of distribution is an arbitrary percentage plan. This is based on the theory that cost arises only from two functions of the bank, the handling of customers' items and the management and investment of funds. The percentage of expense applicable to each of these functions is open to controversy. Experience in many banks indicates that the percentage ranges in the first case from 20 to 30 per cent of the overhead while in the latter case from 70 to 80 per cent, depending on the individual bank and the judgment of the officials.

In this instance, let it be assumed that the overhead to be distributed is $40,000 and that the percentages decided upon are 25 per cent on the basis of items and 75 per cent on the basis of balances.

The amounts then would be $10,000 for items and $30,000, for balances. In order to show the departmental distribution, let it be assumed further that the amount of items handled in the bank for the period was $700,000, of which $550,000 were handled by commercial accounts division, $75,000 by savings accounts, and $75,000 by the other divisions. The distribution of items expense would be made as follows:

$$\frac{550,000}{700,000} \times 10,000 = \$7,857.14 \text{ to commercial department}$$

$$\frac{75,000}{700,000} \times 10,000 = \$1,071.43 \text{ to savings department}$$

$$\frac{75.000}{700,000} \times 10,000 = \$1,071.43 \text{ to others}$$

We must now distribute the $30,000 on the basis of funds that the respective divisions furnished. Again assume that the total funds amounted to $3,000,000 of which $1,500,000 was contributed by commercial accounts, $1,000,000 by savings accounts and $500,000 by the others. The pro rata share of expense would be:

$$\frac{1,500,000}{3,000,000} \times 30,000 = \$15,000 \text{ for commercial department}$$

$$\frac{1,000,000}{3,000,000} \times 30,000 = \$10,000 \text{ for savings department}$$

$$\frac{500,000}{3,000,000} \times 30,000 = \$5,000 \text{ for others}$$

The above plan offers a reasonably sound policy of expense allocation but, of course, the accuracy is dependent upon the judgment of officials who fix the percentage rates. These men being ordinarily mature in experience and knowledge of their institution would be unapt to go wrong to a great degree.

Multi-Base Plan.—There is, however, another method of overhead apportionment that is widely applicable. From its nature, it might be called a multi-base plan. The expenses of the bank are analyzed separately and the most logical base used in pro rating each over the various departments. It is evident that the judgment of the officials enters more or less into the apportionment while in some cases it is relied upon entirely. This plan involves a discussion of each expense item.

Officers' salaries is an item that demands first consideration. This expense may be divided on the basis of loanable funds to be administered. It would not be logical to suppose, for instance, that the president's salary could be divided on the time, hours and minutes

that he devotes to each department since it is what a president *is* and not alone what he does that makes him valuable to the bank even in departments that are never graced by his presence.

It must be appreciated that such service is more than minutes of time or ergs of muscular energy and also that a day is not filled up with the same value of service. The value of the president and other officials is reflected in the income of the bank and every department benefits in proportion to its financial resources. Of course, in cases where a vice-president is in charge of each division his salary would be chargeable alone to that division which claimed his services.

Employes' salaries can be for the most part directly allocated, but those that are of a general nature, such as janitors, watchmen, porters, etc., that can not be applied as a direct cost, might be disposed of on a labor hour basis, each department bearing the same proportion of expense that the direct labor hours of each bears to the total direct labor hours of the bank.

Rent can be apportioned equitably on the basis of floor space. The layout of the bank should be studied and a value assigned to each unit area. The amount assignable to the rest rooms, lobby, etc., should be distributed to each department in the proportion that its floor area bears to the total floor area.

Heat and light can also be allocated on the basis of floor space.

Taxes are charged to the divisions to which they apply. General and income taxes are usually considered as an expense to be borne by capital. Property tax should be distributed on the same basis as rent.

Stationery, Printing and Supplies should be, as far as practicable, assigned to each department on the basis of actual consumption. An elaborate analysis in regard to this item is unnecessary inasmuch as fairly accurate results can be had by a careful survey without great loss of time.

Insurance and Surety Bonds expense is divided in accordance with class. For instance, burglary insurance and surety bonds are prorated on the basis of average funds in the vault; fire insurance on the basis of floor space.

Depreciation is divided among the departments according to its nature, depreciation on building being distributed in the same way as rent, depreciation on furniture and fixtures being fixed on the department in which they are located. No attempt will be made at this time to

explain the various methods of depreciation that may be used. A complete discussion is contained in Chapter 9 of the volume on "Accounting Principles" of the Modern Business Text.

Bad Debts are, like general taxes, considered as a charge to the capital account since they are almost inevitable features of doing business. The amounts of bad debts vary according to the management and should be saddled on the management.

It can be seen that the above plan is extremely practicable and surprising accuracy can be obtained, while amount of work is not prohibitive.

The variation in results obtained by each of the above methods will differ with the banks employing them, due to differences in internal organization, and knowledge and experience of the men entrusted with the responsibility. It can be seen that the two latter plans will give the best results.

Distributing Overhead Among Depositors' Accounts

Having arrived at the cost attributable to commercial accounts by one of the above plans, it now remains for us to divide this cost among the individual depositors in such a way that each will bear an equitable share. This is the most difficult phase of the problem and one which furnishes grounds for frequent disputes among bank accountants.

Let us consider the methods by which this may be done.

The Activity Basis.—In many banks the opinion prevails that the largest part of the bank's expense grows out of the activity function of the bank. That is to say, that the handling of items is responsible for expense.

Assuming for the moment that this is true, we must find the average or individual item cost. In some banks the total overhead would be divided by the total number of all its own checks, city checks and out-of-town checks, drafts and cash deposits, giving an average overhead cost per item. Each item is considered as causing the same amount of expense. Other banks recognize some or all of these as representing a variation in cost, the most common division being its own, the city, and the out-of-town checks and drafts. The cost of each is ascertained. The classification of these items is sometimes done by the cashier, altho more often it is done by the depositor in making out his deposit slip. The separate consideration of coins and

notes is seldom feasible. The individual item cost would of course be direct cost per item, which is found by dividing the direct cost by the number of items, plus the overhead cost per item.

It can be seen that the item cost would be greatly inflated under the above assumption. Then also, since activity alone is taxed, the large comparatively inactive accounts would escape the burden of administration.

The Balance Basis.—The number of exponents of distributing expense on the basis of balance is large and made up of people holding one of two ideas. There are some who believe that it supplies the most accurate means and again those who recognize that activity should be considered along with balance but who contend that the amount of work is prohibitive.

Under this plan the total balance of the accounts is divided into the total direct and indirect expenses, the result being the average cost per dollar of account balance.

The accuracy of this method depends on the accounts being of uniform activity. It is manifest that small accounts in a constant state of activity would not bear expense in proportion to the amount of work they caused.

The Number Basis.—There is another manner of distribution which might be designated as the number basis. Under this scheme all expenses of the department both direct and indirect would be distributed equally among all the accounts, on the theory that the various types of service are maintained for equal use by all depositors, and irrespective of whether or not they have been equally used they should be equally taxed. It is the same idea that underlies the charging of uniform dues in clubs or associations regardless of whether or not the members make full use of the privileges.

This plan fails to make allowance for character of the accounts, and, while it disposes of the expense in a blanket fashion, yet it obscures the ultimate end toward which we are working, the net cost of the individual account.

Activity and Balance Basis.—By combining the two principal factors of activity and balance a reasonably accurate distribution of expense is made. The expenses are divided on a definite percentage basis into item and balance expense.

The activity or item cost is then determined by adding direct expenses to overhead and dividing the sum into the item expense

and balance expense according to the pre-determined ratio, as for instance, 25 and 75 per cent.

Assuming that the portion due to items for a certain period is $1,457.50 and the number of items 55,000, then the cost per item will be:

$$\$1,457.50 \div 55,000 = \$.0265$$

This figure represents the average item cost which is usually as far as a bank desires to go in costing. The ordinary accounts do in the course of a year have about the same relative number of different kinds of items and any account that is exceptional in this respect can be separately treated.

For those banks, however, that wish to find individual item costs, it is necessary to divide the various kinds and keep individual records. Thus it might have its own checks, city checks, out-of-town checks, drafts, cash deposits, etc. Each item would have to be "weighted" according to the time of handling and the type of check necessary so as to find the proportion of total activity expense assignable to each.

The amount of expense due to administering balance would be $4,372.50. Assume that the total balance of the accounts considered is $330,748.87, then the cost per dollar will be:

$$\$4,372.50 \div \$330,748.87 = \$0.1322, \text{ or } 1.322 \text{ per cent}$$

In figuring balance cost it is the view of some bankers that interest on capital should be added to the proportion of expense on the theory that profits are not really made until the interest that capital would earn if invested outside the business is deducted. The balance cost would be slightly increased by this consideration. When the percentage plan is used in ascertaining department expense the part due to items and that due to balance is readily available and it is an easy matter to arrive at costs per item and per dollar.

Combined Factor Basis.—In addition to the factors of activity and available balance there is another factor which should enter into the calculation, called number. This is the expense of procuring and carrying more accounts.

It is obvious that an increase in number of accounts would mean an increase in overhead.

The combined factor plan takes into consideration this fact in conjunction with the others mentioned, activity and balance. Under

this plan all expenses both direct and indirect of the department are separated into these three classes according to the nature of the expense. The following distribution is made in a circular issued by the Federal Reserve Bank of New York, and is universally applicable.

Officers' salaries do not admit the application of a rigid mathematical division, but judgment founded on experience in the particular bank would be the basis used.

Employes' salaries should be divided according to the nature of the work on a time basis. For instance, salaries of employes whose time is spent in handling bookkeeping or accounting should be allotted to number; salaries of watchmen and the like, to balance.

Printing, stationery and supplies should be apportioned according to their use, *i. e.* supplies used in handling items to activity, while those used in bookkeeping, to number.

Rent, light, heat and fire insurance should be divided between activity and number. A certain proportion of these expenses would be necessary to administer inactive accounts. Whatever proportion judgment dictated would be allotted to number and the remainder should go to activity.

Telegraph and telephone should be divided on the basis of consumption.

Burglary insurance obviously would be chargeable to balance as would also surety bonds.

Depreciation on building should be charged largely to activity considering a small portion applicable to number. Depreciation on fixtures is chargeable to the expense divisions into which work of the branches fall. Depreciation on vault should be borne by the balance factor.

The total of the "activity" expense divided by the total number of items gives the item cost; the total of the "balance" expense divided by the total available balance results in the administration cost per dollar; the total of the "number" expense divided by the number of accounts gives the flat charge per account.

This method considers all factors of expense in finding the amount chargeable for each factor, and allocates each to the depositors' accounts in the proportion that the factors apply. The judgment of the officials will vary, as will circumstances in the different banks.

The same refinement in item costs can be accomplished in this case as was outlined in the previous method.

The Composite Basis.—In banks of such size and development that regular statistical and analysis departments are included in their organizations, a scientific method may be adopted that is based on the accuracy of refined statistics.

The shortcomings of methods based upon one factor or another have been discussed and the point might again be emphasized that when one factor is used alone a certain class of accounts are discriminated against and when another factor is employed another class of accounts are adversely affected. It is clear that the use of all three factors is most equitable, providing the judgment is sound.

The composite plan, however, relies on accurate statistics and strictly mathematical procedure in applying simultaneously these factors. Individual judgment is, as far as possible, eliminated and the solving of the factors placed on a scientific basis.

Since it is admitted that as activity of accounts increases, as the balances become multiples of those formerly carried and as the number of accounts grows, the overhead expense increases, it may readily be seen that some relationship exists between the varying overhead cost and these three factors, the changing activity, the growing balances, and the increasing number of accounts.

There may be other causes of that variation; *e. g.,* there is recognized a seasonal variation; the number of accounts opened during the month might be separated from the number carried, etc. But it is highly desirable to keep the equation of relationship as simple as possible, consistent with a satisfactory control of the other causes.

So we say that the total overhead, Z, depends upon (*i. e.,* is a function of) the total activity number, X, the average available funds, Y, and the average number of accounts carried, N. And since there is no indication that this function is not simple, or linear as we say, we express the functional relationship by the equation—

$$AX + BY + kN = Z,$$

in which A, B, and k may be called rates, per activity unit, per thousand of available funds, and per account, respectively.

In brief, the method proposed is to compute the most probable values of the three rates, A, B, and k, in view of the values compiled month by month of the four variables, X, Y, N, and Z, for at least the past six months, including the month of analysis as the last. Later and regularly, the computation should be made on the basis

of twelve months to take care of the seasonal changes. Then these *most probable rates,* determined by the continually varying relationships amongst the factors involved, *when all the work of the bank relative to the domestic accounts is considered, are taken as the rates to be used in the analysis of the individual accounts for the month, as being the most equitable average rates obtainable.*

That gives a fair, average solution, *independent of personal judgments* as to whether 25 per cent or any other percentage should be distributed on one basis and the remainder on another basis. The rates are determined in view of the actual, recorded business of the bank, for the three recognized, coordinate and mutually inclusive factors.

How it is Done.—The mechanical part of this is not nearly so bad as it may seem to those unaccustomed to such calculations.

A re-cap sheet with fourteen columns will suffice for as many months as it has horizontal rulings or lines. Thus the volume of this record will not become a burden during the lifetime of any one president of the bank. A sample of such a sheet, filled in for six months, is presented in Figure 1. The first column gives the years and the

TABULATION of STATISTICAL DATA

for the

DISTRIBUTION of the OVERHEAD

MONTH	X ACTIVITY	Y AVERAGE BALANCE	N NUMBER of ACCOUNTS	Z OVERHEAD	ΣX²	ΣY²
1918.						
JULY	350,714	38,286 M	3,141	15,201	123,000,309,796	1,465,817,796 M
AUGUST	309,047	37,355 M	3,144	14,260	218,510,358,005	2,861,213,821 M
SEPTEMBER	337,756	38,748 M	3,150	16,764	332,589,473,541	4,362,621,325 M
OCTOBER	364,969	38,979 M	3,171	16,553	465,791,844,502	5,861,983,766 M
NOVEMBER	312,657	41,079 M	3,190	16,429	563,546,244,151	7,569,468,007 M
DECEMBER	313,802	42,724 M	3,214	16,537	662,017,939,355	9,394,808,183 M
1919.						
JANUARY						
FEBRUARY						

ΣN²	ΣXY	ΣXN	ΣYN	ΣXZ	ΣYZ	ΣNZ
9,865,881	13,427,436,204M	1,101,592,674	120,256,326M	5,331,203,514	561,985,486M	47,746,341
19,750,617	24,971,886,889M	2,073,236,442	237,700,446M	9,738,213,734	1,114,667,786M	92,579,761
29,673,117	38,059,256,377M	3,137,167,842	359,756,646M	15,400,355,318	1,764,239,158M	145,386,381
39,728,358	52,285,383,026M	4,294,484,541	483,359,055M	21,441,687,175	2,409,485,645M	197,875,944
49,904,458	65,129,019,931M	5,291,860,371	614,401,065M	26,578,329,028	3,084,345,536M	250,284,454
60,234,254	78,535,896,579M	6,300,419,999	751,716,001M	31,767,672,702	3,790,872,324M	303,434,378

Report No 45 Figure 1

months. The next four columns give in turn the activity number, X, the average available funds, Y, the number of accounts, N, and the

overhead, Z, month by month in order, one line across the sheet for each month. Each of the following nine columns contains a sum of the products of two numbers each. Σ is the Greek letter Sigma, which is used to express, "the sum of" whatever expression follows it. Thus ΣX^2 means "the sum of X^2 values"—read X square, meaning the product of X by itself, X—for each month down to and including the one on the same line with it. To illustrate with smaller numbers, say the columns were—

X	Y	then	ΣX^2	ΣY^2	ΣXY
3	7	we	$3\times3=9$	$7\times7=49$	$3\times7=21$
4	8	would	$9+4\times4=25$	$49+64=113$	$21+4\times8=53$
5	9	have	$25+5\times5=50$	$113+81=194$	$53+5\times9=98$
5	10	the	$50+5\times5=75$	$194+100=294$	$98+5\times10=148$
6	10	following	$75+6\times6=111$	$294+100=394$	$148+6\times10=208$

It is worthy of such special note that we repeat in other words, that, at the end of each month, it is necessary to fill into Figure 1 only the four numbers from the records of the month, and, on a calculating machine, add to the previous number in each of the last nine columns the product of the proper two numbers of the four entered for the present month of analysis. This is not at all difficult, and can be done in a very few minutes. After twelve months have been filled in, subtract each time the number in the same column for the same month of the previous year as the month that is being filled into the Form. Thus the nine sums will always thereafter include only the past twelve months' figures. Thus, if filling in January of the second year, add the product for that month to the number above, on the line of December data, and subtract the value for the previous January. All else that remains to be done to compute the three rates for the month is the solution of three simultaneous linear equations, which will now be described.

It can be shown that all that is necessary in order to get the most probable values of the rates, A, B, k, is to solve the following three quotations:

$$\begin{aligned} \Sigma X^2A &+ \Sigma XYB &+ \Sigma XNk &= \Sigma XZ \\ \Sigma XYA &+ \Sigma Y^2B &+ \Sigma YNk &= \Sigma YZ \\ \Sigma XNA &+ \Sigma YNB &+ \Sigma N^2k &= \Sigma NZ \end{aligned}$$

whose coefficients are the nine numbers from Figure 1.

Because these coefficients will be large numbers, the solution may tax the patience of many, altho the principles and methods involved are familiar to them.

The writer prefers to solve by means of determinants, first dividing out of each column the corresponding coefficient of the equation whose coefficients are least thruout. This gives a row of ones in all four determinants. By subtracting the elements of columns suitably there remains to be evaluated four two-rowed determinants, from which the values of A, B, and k are got by a single division in each case. An illustration of the working of his method will be considered later.

Since in the analysis of the individual account the variables are no longer the totals used above, but simply the activity number, the average available cash balance and the overhead chargeable to that account, we write the equation for determining the overhead chargeable to the account thus—

$$Ax + By + k = z,$$

in which A, B, and k are the rates determined on the basis of all the accounts as shown above.

Further, since in the analysis of each account the same quantities, x and y, are used in computing other items than overhead, it is advisable to adjust the coefficients A and B so as to include the direct activity cost and the several interest items of the analysis; thus the complete analysis, if exchange received and paid is included, may be made by the solution of a single equation, in the case of each account to be analyzed. On the proper machine these equations may be solved at the rate of 100 to 200 an hour. The aggregate of profits and losses will furnish a check on the accuracy of the work and the efficiency of the method. Only those accounts that need special attention as shown by the results would be thrown out for detailed analysis to be shown to the officers.

Some have said that their aim was to determine the "breaking point" of an account; that is, what balance must be maintained so that the bank shall just "break even" in handling the account. From what has been said the reader will know that such aim is futile. Within a year, it was shown before the New York State Bankers' Association that even a million-dollar balance may not be profitable. There are *three* main factors, independent of the way the bank conducts its business, no one of which tells the whole story of an account.

It can be appreciated that the above method, by maintaining statistics revised constantly, will give greater accuracy than those

plans which compute their basic figures from averages.

As an illustration of the mathematics of the above method, let us consider a purely domestic problem.

If in your home, five pounds of butter are purchased thruout the week at a total cost of $3.50, you at once know the average price is seventy cents. But, say that you are handed a correct record, covering a month or two, stating *for each week separately* the number of pounds of butter, of dozens of eggs, and of pounds of meat bought, and only the total amount of each week's purchases, then the computation of the most probable average price of each of the three commodities, and the amounts by which your answers may as like as not to be in error, becomes an appreciably different problem.

Yet this is just the problem of distributing the overhead expense, which depends upon at least three varying factors. The actual practice of *statistical cost analysis* can be carried out by a young man or woman who learned how to solve simple equations of three unknown quantities. But, as is always the case, constructive development requires the trained mind and experienced officer. Large corporations are learning that it is becoming necessary to replace cut and try methods by scientific research. The industrial chemist came in among the first in this movement, but other research workers will gradually be employed to determine the best and most economical procedures and methods. And the scientist must come to know and act upon true and well-established business principles.

In determining the cost of several items we are accustomed to the bill or statement form, as for example,

3 lbs. Butter, @ .63	$1.89
4 doz. Eggs, @ .75	3.00
5 lbs. Beef, @ .48	2.40
Total	$7.29

Now instead of thinking vertically, it is desired to think horizontally, and we put,—

$$3 \times 63 + 4 \times 75 + 5 \times 48 = 729$$

This may be called a *cost equation* which, in general, may be written

$$Ax + By + Cz = K,$$

in which A represents the price and x the number of pounds of butter;

B is the price and y the number of dozens of eggs; C stands for the price, and z the number of pounds of beef; and K is the cost. In regular business, the six factors of the first member are known and it is desired to know the cost, K.

But say that there was presented the following record of weekly purchases in 1896:—

2 lbs. Butter, 3 doz. Eggs, 6 lbs. Meat, Cost $1.61
3 lbs. Butter, 2 doz. Eggs, 8 lbs. Meat, Cost 1.99
3 lbs. Butter, 4 doz. Eggs, 4 lbs. Meat, Cost 1.73

without the price of any of the commodities.

To determine the several prices, *assuming that they remained the same during the three weeks,* we should have to solve the three equations,

$$2A + 3B + 6C = 161 \qquad (1)$$
$$3A + 2B + 8C = 199 \qquad (2)$$
$$3A + 4B + 4C = 173 \qquad (3)$$

SOLUTION—The sum of the three equations, member by member, is

$$8A + 9B + 18C = 533 \qquad (4)$$

3 times (1) is $6A + 9B + 18C = 483 \qquad (5)$

Subtracting $2A = 50$, whence $A = 25$

2 times (3) is $6A + 8B + 8C = 346 \qquad (6)$

Subtracting (2) from (6), we get $3A + 6B = 147$, in which we substitute the value of

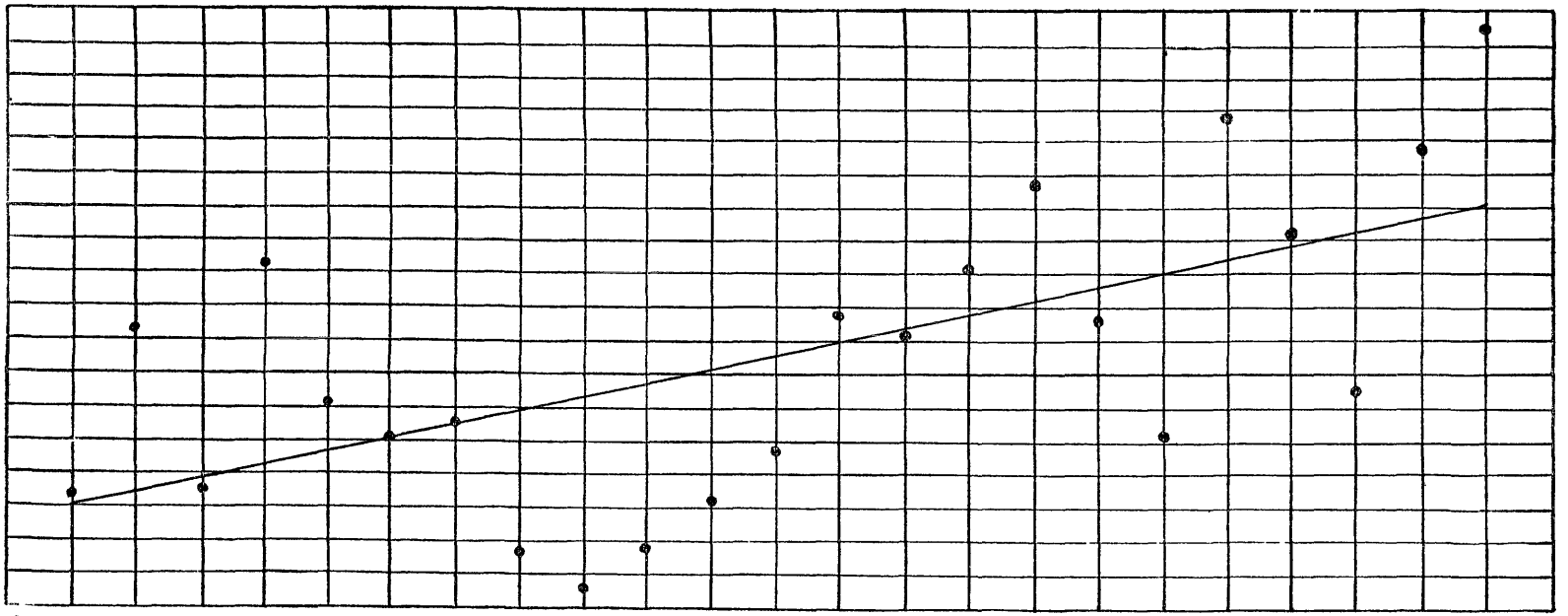
$A = 25$, and obtain $75 + 6B = 147$, whence $B = 12$

Substituting the values of both A and B in equation (1), we find $C = 12\frac{1}{2}$

In the record of the fourth week were:

3 lbs. Butter, 3 doz. Eggs, 6 lbs. Beef, Cost $1.86. The above prices would satisfy the equation, and we *might* say that prices are likely very regular and have remained the same as during the previous three weeks. Yet there is no assurance of this, for there is an endless variety of small changes in the three prices which would leave the total cost unchanged; for example, the prices of butter and eggs might each have dropped a cent and that of beef increased a cent.

Say the cost for the fourth week was $1.95 instead of $1.86. We might then suggest that possibly the 9 cents increase in cost was caused by the price of eggs rising to 15 cents; or of butter to 28; or of beef to 14 cents. There is, however, no certainty that any one of these is the proper interpretation of the variation. Butter at 20, eggs at 15, beef at 15 as well as butter 24, eggs, 14, beef $13\frac{1}{2}$, are also both possible and reasonable solutions. Similarly, there is a three-



Report No 45 Figure 2

fold infinite number of sets of prices that satisfy the equation. Yet it must be pointed out that very many of these possible sets would be absurd thru the unreasonable relationships in the prices of the several commodities, and so could be cast out as altogether impossible.

It must be pointed out and borne clearly in mind that for an equation in several variables, there can be no assuredly correct statement as to which set of values of the variables corresponds with the facts, unless the proper number of additional conditions is given. If such conditions are not given, we may proceed to make assumptions, and the object may reasonably be to secure the most probable solution, by asking that the sum of the squares of the deviations from the selected solution shall be a minimum. To illustrate, we give a line that has been fitted among a number of points in a plane as in Figure 2. Since the several costs in the equation used to distribute the overhead are, in the nature of the case, not subject to marked variations, we may compute those costs and the probable errors, in the way indicated.

In the above method considerable refinement in activity cost is attained. The ratio of cost which one item causes as compared to another is considered by finding the total item or activity number and "weighting" each item.

It will be recognized that the refined plan submitted would be most successfully operated in large and highly organized banks where a statistical department is maintained.

Finding the Cost of Any Account

Having considered the plans of applying to the individual accounts their proportionate share of the costs, and noted that some bankers tax an account on its activity alone, others on balance alone, still others on both these bases while a fourth class taxes upon a more accurate analysis of costs, recognizing besides the two factors mentioned, the basis of number, our natural conclusion is that the plans that consider all three factors are the ones that most adequately solve the problem.

So, having worked out the rates of each factor, it is only necessary to apply them to each account to get its cost. If, for example, our results were activity $.025 per average item, the balance rate $.005 per dollar and the number charge $5.00 per account, the activity cost of each account tested would be the number of items times $.025, the

EARNINGS RATES for ..... DATE

RATE	BILLS DISCOUNTED	BONDS	LOANS	ACCEPTANCES PURCHASED	OTHER CLASSES	VALUE TOTALS	INTEREST TOTALS	% Of TOTAL RESOURCES
VALUE TOTALS						365 GRAND VALUE TOTAL		
INTEREST TOTALS							GRAND INTEREST TOTAL	
AVERAGE RATE							AVERAGE EARNINGS RATE	
% Of ALL RESOURCES								

Report No. 45 Figure 3 *Divide* GRAND VALUE TOTAL *by 365 and write the quotient on the line below it. This quotient is divided into the* GRAND INTEREST TOTAL *which stands next to the right. That quotient is written just below and is the* AVERAGE EARNINGS RATE.

balance cost would be the number of dollars times $.005 and the number cost would be the flat charge of $5.00. The total cost would be the sum of these factors plus direct costs if not considered in the above and special direct charges to the account.

Analysis of Income

Sources.—In order, however, to determine the profit on an account, we must find the gross income of each. This problem is simple as compared to finding the cost.

The income of an account depends on the average net cash balance available for investing and the rate of interest the bank receives on its investment.

Let us first consider the sources of income and the consequent rates received which go to make up the average earning rate. The ordinary sources are, bills discounted, loans, investments, bank balances, acceptances, etc. The funds of the bank are invested in each of these classes and the return is different from each.

Rates.—It is a distinct advantage for the bank to know the amount of money invested in each class and the separate earning power or rate. It is information that all officers and directors would welcome as a guide in the future purchasing of paper. Figure 3 shows a method of presenting the desired information.

As illustrating the appearance of the grand total items in this form, consider the following:—

365		
56,629,750.00		
155,150.00	8,455.68	
	0.0545	

The amount $56,629,750.00 is the sum of the row and also of the column of value totals. It is divided by 365 and the quotient is written below it, $155,150.00. This in turn is divided into the sum of the interest totals, $8,455.68, and the quotient is placed below as 0.0545. The total of all resources, including the non-productive resources, if they are not entered at zero rate, is ascertained and divided into the totals of each row and column separately to give the respective per cent of all resources.

From Figure 3 the amount invested and the separate return from each source is obtained. Available funds from all sources are merged for investment. The income also is consolidated and the average rates of returns found.

RECORD OF AVAILABLE CASH

ACCOUNT OF _____ 1920

(DISREGARD CENTS)

Date	1 Day	2 Days	3 Days	4 Days	5 Days	6 Days	7 Days	8 Days	Ledger Balance
26									
27									
28									
29									
30									
31									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
Total									
Multiply by		2	3	4	5	6	7	8	Divide by 30 or 31 for Average Daily Balance
Result									
Total Float (sum of above results)									
Average Daily Float (total divided by 30 or 31)									
Difference Average Overdraft / Daily Cash Balance									

Report No. 45 Figure 4

Finding the Profit or Loss of Any Account

Income of the Account.—The earning power of an account is the rate times the daily available net cash. It is evident that when checks are deposited the amount that they represent does not become immediately available for investing but represents a floating amount that earns no interest. The time necessary for collection varies. This amount must be considered as being deducted from the ledger balance to furnish a cash basis of earning power. Figure 4 represents a method of computing the average daily cash balance and shows the average overdraft upon which the bank should demand interest. Since this overdraft is really a loan, the bank is justified in charging for it.

Figure 5 is another type of the same figure which has the distinctive feature of showing individual daily overdrafts. In the case of Figure 4, overdrafts, by reason of delayed items, are not detected if the average daily balance for the month is larger than the average daily amount of delayed items. This form possesses additional value in that it can be used as an interest sheet.

In regard to figuring interest it must be clearly borne in mind that interest does not accrue until a night has intervened. Money deposited any time today, if it be the first thing in the morning, does not accrue any interest until tomorrow morning; and it is just the same if the deposit is made the last thing this afternoon. When money is transferred from one bank to another without allowing a night to intervene, there should be no loss in interest. Great care should be taken in the bookkeeping practice as to what is considered the balance.

To give a concrete illustration, say that at the close of business last night there was an available balance of five hundred dollars on the ledger under date of the tenth instant. The amount should appear on Figure 5 of your bank under date of the eleventh, meaning that one day's interest is due you on the eleventh on that amount. Further, say that on the eleventh you deposit:

Money immediately available.....	$300.00	
Items delayed 2 days.....	275.00	
Items delayed 4 days.....	159.00	$734.00

and that your checks are paid to the amount of $874.62. Then Figure 1 at your bank should read as follows

			Total	Cr.	Dr.	Cr.
11				500.00		500.00
12	275	159	434	359.38	75.00	
13	275	159				
14		159				
15		159				

Here only cents have been omitted. Frequently, for interest purposes, the units and sometimes the tens of dollars are also omitted. Thus your account on the twelfth is really overdrawn seventy-five dollars so far as the bank is concerned, altho your ledger account shows a credit of three hundred fifty-nine 38/100 dollars.

In considering available funds it is to be remembered that a certain percentage of funds must be kept in the vault as a cash reserve upon which no interest is carried. This amount should be deducted of course before figuring account earning.

Analysis Department

Account of First Exemplar National Bank,

From the 26th of January 1919. Somewhere, N. Y.

DATE	ITEMS NOT AVAILABLE — DETAIL												TOTAL		LEDGER BALANCE				NET CASH BALANCE			
													Thousands	Hds.	DR. Thousands	DR. Hds.	CR. Thousands	CR. Hds.	DR. Thousands	DR. Hds.	CR. Thousands	CR. Hds.
Sun 26	1	63	1	50	1	75							4	88			3	68	1	20		
27	1	63	1	50	1	75							4	88			3	68	1	20		
28	1	63	2	57	1	75							5	95			9	75			3	80
29			2	57	5	00							7	57			9	60			2	03
30	1	47			5	00							6	47			13	86			7	39
31	1	47			1	25							2	72			35	15			32	43
1			3	88	1	25							5	13			4	97		16		
Sun. 2			3	88	1	25							5	13			3	97	1	16		
3			3	88	1	25							5	13			3	97	1	16		
4	2	15	3	88									6	03			12	75			6	72
5	2	15			1	74							3	89			12	75			8	86
6	1	68	2	16	1	74			75				6	33			21	50			15	17
7	1	68	2	16	1	70			75				6	29			12	88			6	59
8	1	15			1	70	1	67					4	52			17	35			12	83
SUN. 9	1	15			1	70	1	67					4	52			19	74			15	22
10	1	15			1	70	1	67					4	52			19	74			15	22
11	1	15		86	2	95							4	96			22	25			17	29
Legal Hol. 12	3	17		86	2	95	1	21					8	19			23	78			15	59
13	3	17		86	2	95	1	21					8	19			23	78			15	59
14		90		86			1	21					2	97			60	45			57	48
15		90					1	21					2	11			49	27			47	16
SUN. 16		90	2	73									3	63	10	80			14	43		
17		90	2	73									3	63	10	80			14	43		
18			2	73									2	73			84	65			81	92
19			2	73	1	45							4	18			36	64			32	46
20		80	1	00	1	45							3	25			17	92			14	67
21		80	1	00									1	80	13	31			15	11		
Legal Hol 22					2	76							2	76	8	00			10	76		
SUN. 23					2	76							2	76	8	00			10	76		
24					2	76							2	76	8	00			10	76		
25	2	50	1	59									4	05			30	59			26	54
TOTALS													141	93	58	91	554	57	6 81	13 16	434	96
DAILY AVERAGE and INTEREST													4	56	1	90	17	89	13	52	27	18

Report No. 45 figure 5

Profit or Loss of the Account.—The income-earning balance having been found, it is a simple matter to find the account earning, to which amount direct items of income are added to get total income. The profit or loss is then obtained by subtracting the smaller from the larger amount.

Assembling Data

Analysis Sheet.—There are many forms in existence on which the vital data may be assembled. They will vary according to the system used and refinement attained. Figures 6 and 7, generally called analysis sheets, are presented as representing ones that show the account data desired by the bank executive.

The main purpose of the discussion has been accomplished in showing how to work out the three cost factors applicable to each and every account. Once having obtained these factors, *i. e.* activity, balance and number costs, the cost of any account may be found. Likewise, having ascertained the average rate of earning, the income of the account may be found by applying this rate to the available cash balance. The profit or loss becomes at once apparent. From the above it can be seen that to find profit or loss on an account after the basic data are accumulated, it is necessary simply to keep an item record and a cash balance record for the period of test of any account.

Departmental Data.—As an incidental figure the departmental earnings may be readily found and, knowing the expense, the profit is revealed. This figure will show which departments need attention or development; it will show what class of business to restrict, and what classes to solicit; and it will also guide future appropriations for advertising.

Constructive Use of Data.—Mindful of the facts as presented, the banker must use great discretion in working out remedies for evident maladjustments. It would be folly, for instance, to demand that all accounts, without exception, showing a loss should be canceled or charged a certain fixed sum. There enters into the consideration of each account an element known as quality. Quality is another name for influence or good-will that an account carries with it.

In looking into the various accounts from this angle the executive may find that one unprofitable account was that of a woman whose husband maintained a highly profitable business account with the institution; or perhaps another losing account was one of an influ-

Compiled by _____ Checked by _____

ANALYSIS OF ACCOUNT OF

_____

_____ DATE _____

Period of Analysis from _____ 19 to _____ 19 _____ Days

Average Daily Ledger Balance _____

Less Average Daily Delayed Items _____

Less Reserve at % _____

Average Daily Loanable Balance _____

Interest Terms _____

	Expense	Income
Income Earning Balance: $ _____ @ _____ % per yr. Interest paid on credit balance @ ____ % Interest due on overdraft @ ____ % Exchange Paid Received Special Direct Costs: Pay Roll Credit Investigation Miscellaneous		
TOTAL		
Gross Profit or Loss Overhead Charges: Activity Items @ ____ ea. Balance @ ____ per mo. (or year) Number @ ____ per mo. (or year)		
NET PROFIT OR LOSS		
REMARKS:—		

Report No. 45 Figure 6

Compiled by	Checked by	ANALYSIS of ACCOUNT of _____ DATE _____ Federal Res. Dist. # _____

PERIOD of ANALYSIS from _____, 19__ to _____, 19__. _____ DAYS.
AVERAGE DAILY LEDGER BALANCE . . . . . $
LESS AVERAGE DAILY DELAYED ITEMS . . . . . $ _____

$
LESS RESERVE AND UNEMPLOYED FUNDS, ___ % . . . . . $ _____
AVERAGE LOANABLE FUNDS . . . . . $ _____

INTEREST TERMS :- _____
NUMBER of DAYS in PERIOD showing NET DEBIT BALANCE . . . . . ____DAYS.

TOTAL NET CASH BALANCE - DEBIT (Overdraft or Involuntary Loan). . . . $
" " " " - CREDIT . . . . . $
LESS ___% RESERVE & UNEMPLOYED FUNDS . . . . $ _____
TOTAL LOANABLE FUNDS for one day . . . . . $ _____

To US the ACCOUNTS.	COST	INCOME
LOANABLE FUNDS for one day at ___% per ANNUM		
INTEREST PAID ON CREDIT BALANCES at ___%		
INTEREST DUE on OVERDRAFTS at ___%.		
EXCHANGE :- PAID and RECEIVED		
DIRECT EXPENSES :-		
ACTIVITY NUMBER, _____ UNITS at _____		
CASH DEPOSITED, $_____ at _____ per $1000		
CURRENCY, . . . $_____ at _____ per $1000		
SPECIAL DIRECT COSTS:		
SERVICES : COUPON COLLECTION, _____ at ____		
CREDIT INVESTIGATION, _____		
PAY-ROLL, _____		
OVERHEAD due to -		
ACTIVITY, _____ UNITS at _____		
AVERAGE LOANABLE FUNDS, $ _____ at ____		
FLAT CHARGE per ACCOUNT per MONTH, ...		
TOTALS, ...		
NET COST or INCOME of this ACCOUNT this MONTH, . . .		

REMARKS :- _____

Report No 45 Figure 7

ential clergyman, doctor or lawyer in the community who had sent many profitable customers to the bank. Again, the loss may have been caused by an account of a young manufacturer or professional man just starting out in business. Such an account, while causing a small loss now, may become a powerful income producer.

The banker would, in such cases as the above, manifestly show lack of judgment in excluding the customers or in demanding a larger balance from them. Each account must be considered on its own merits. It is the quality of each that should determine the action to be taken.

Conclusion.—The system presented will disclose basic facts of the business and enable the banker to know profit or loss on individual accounts or departments. It furnishes sound information that he may rely upon in drawing essential comparisons and in formulating administrative policies.

It will now be appreciated that a cost accounting system does not necessarily involve a serious disturbance in the present accounting methods, nor a loss in flexibility in handling business. It rather implies proper classification of accounts so that data may be assembled by means of which profits may be increased and losses prevented.